
CYRTOCARPA KUNTH (ANACARDIACEAE) IN SOUTH AMERICA¹

John D. Mitchell² and
Douglas C. Daly²

ABSTRACT

Cyrtocarpa has previously been known only from Baja California and western Mexico; here we report two species of the genus from South America. *Cyrtocarpa velutinifolia* (Cowan) Mitchell & Daly, presented here as a new combination, was originally published as a *Bursera* and later transferred to *Tapirira* (Anacardiaceae). The Anacardiaceae and Burseraceae show frequent morphological convergence in the drier tropics; moreover, in several genera they display strong similarities in staminate flower structure. *Cyrtocarpa velutinifolia* occurs in savannas and granitic outcrops in Colombia, Venezuela, Brazil, and Guyana. *Cyrtocarpa caatingae* Mitchell & Daly, a new species represented by four collections from the dry thorn-scrub vegetation of Bahia, Brazil, resembles the Mexican *C. procera* Kunth and appears to be most closely related to it.

Cyrtocarpa Kunth is a genus heretofore known from two Mexican species, *C. procera* Kunth and *C. edulis* (Brandegge) Standl. Now, two additional species are recognized in South America. One of them was originally described in the Burseraceae; the other was discovered recently in collections from Bahia, Brazil.

The Burseraceae and Anacardiaceae are accepted as being closely related by most contemporary authors (e.g., Cronquist, 1981; Takhtajan, 1980; Thorne, 1976). The two families show considerable morphological convergence in dry tropical habitats, where species of both families display a densely branched, tortuous habit; succulent branchlets; leaves that are imparipinnate, congested toward the branchlet apices, and deciduous; and drupaceous fruits (eventually dehiscent in Burseraceae). For example, *Bursera microphylla* A. Gray and *Pachycormis discolor* (Benth.) Coville are sympatric in Baja California and are very similar in appearance (pers. obs.). In arid portions of East Africa, some species of *Commiphora* Jacq. (Burseraceae) and *Lannea* A. Rich. (Anacardiaceae) are difficult to distinguish (J. B. Gillett, pers. comm.). In southern Africa, some species of *Commiphora* and *Rhus* L. show a strong resemblance.

The occasional similarities in the structures of the staminate flowers of these two families led Cowan (1952) to describe an anacardiaceous plant from

Guyana as *Bursera velutinifolia*. This species has since been collected in Brazil, Colombia, and Venezuela (Fig. 1). In the staminate flowers, the only characters that place the species out of the Burseraceae are the imbricate (induplicate-valvate in *Bursera*) petals and the pistillode that is 3–5-lobed from the base (always 3-lobed in *Bursera*). The deciduous habit of this species is also characteristic of *Bursera*.

After examining pistillate flowers, Marcano-Berti (1986) transferred *B. velutinifolia* to *Tapirira* Aublet (Anacardiaceae). This transfer to Anacardiaceae is supported by the solitary, apotropous ovules, apically suspended within the locules (vs. two epitropous, laterally attached ovules in Burseraceae); carpels more than three (2–3 in *Bursera*); and mesocarp and endocarp distinct. Moreover, the styles become separated in the developing fruit, whereas in all Burseraceae there is a single, occasionally branched style. We agree with the implication of Marcano-Berti's transfer that the species belongs in the tribe Spondiadeae (Engler, 1882) because of its apically suspended ovules and the ovary with usually more than three carpels. Its affinity with the Spondiadeae was recognized by the indigenous population in Venezuela: it is called "jobillo," and the common name for *Spondias* is "jobo." However, examination of the available material has brought to light several fundamental

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² New York Botanical Garden, Bronx, New York 10458, U.S.A.

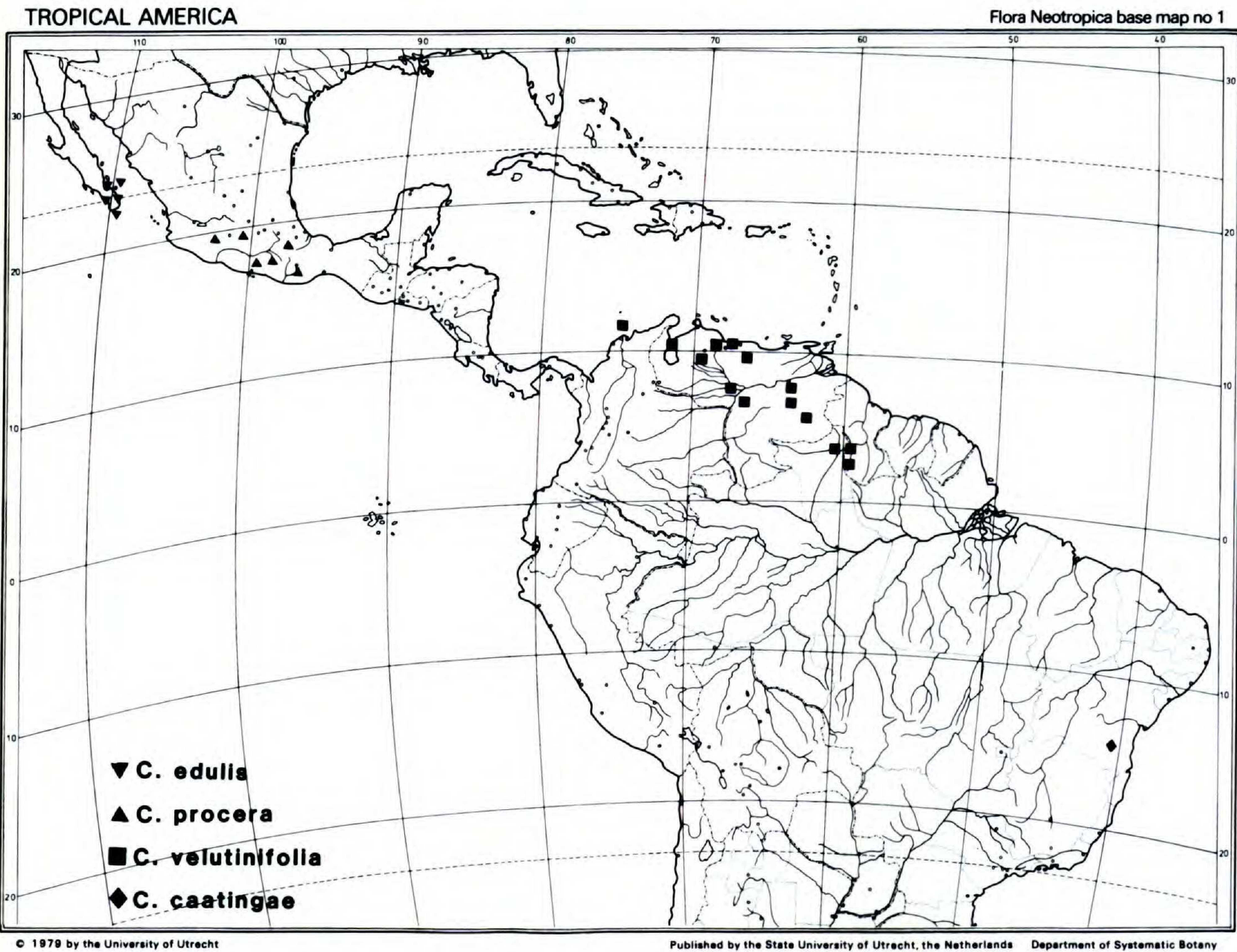


FIGURE 1. Distribution of *Cyrtocarpa* species. This map is Flora Neotropica base map no. 1, published by the State University of Utrecht, The Netherlands.

characters that preclude its placement in *Tapirira* and necessitate its transfer to *Cyrtocarpa*. These characters are summarized in Table 1.

Since we have reexamined *Cyrtocarpa*, we present below a key to the neotropical genera of Spondiadeae, a description of *Cyrtocarpa*, and a key to the species of the genus; one new combination is made and a new species is described.

KEY TO THE NEOTROPICAL GENERA OF SPONDIADAEAE

- 1a. Leaflets with intramarginal vein; stone consisting of bony endocarp enclosed in a fibrous matrix *Spondias*
- 1b. Leaflets without intramarginal vein; stone cartilaginous or bony, fibrous matrix lacking.
 - 2a. Plants deciduous; leaves congested at branch apices; pistil(lode) glabrous, stone with one or more opercula (lids).
 - 3a. Buttresses present; in pistillate flowers, all locules containing an ovule; stone depressed-globose, pentagonal or turbinate; opercula 5–6; seeds usually 5–6; moist forests *Antrocaryon*
 - 3b. Buttresses absent; in pistillate flowers, only one locule containing an ovule; stone slightly oblique-oblong, obovoid,
 - 2b. Plants evergreen; leaves not congested at branch apices; pistil(lode) pubescent; stone without opercula *Tapirira*

- or ovoid; opercula 1–5; seed 1; dry forests, savannas, and thorn scrub *Cyrtocarpa*
- 2b. Plants evergreen; leaves not congested at branch apices; pistil(lode) pubescent; stone without opercula *Tapirira*

***Cyrtocarpa* Kunth in HBK, Nov. Gen. et Sp. 7: 20, t. 609. 1824. TYPE: *Cyrtocarpa procera*.**

Dasycarya Liebm., Vidensk. Meddel. Dansk Naturhist. Foren. Kjøbenhavn 1853: 98. 1854. TYPE: *Dasycarya mexicana*.

Small to medium-sized polygamodioecious trees of dry to arid habitats, branchlets somewhat succulent (drying wrinkled), resin apparently nonallergenic. *Leaves* deciduous, congested toward the branchlet apices, imparipinnate; lateral leaflets sessile or short-petiolulate, margin entire, densely pubescent on both surfaces, venation eucamptodromous. *Inflorescences* subterminal, paniculate (pseudospicate in *C. velutinifolia*), initiated in leafless condition. Flowers 5-merous, aestivation imbricate; petals patent at anthesis; diplostemonous; disk intrastaminal, annular, crenulate, fleshy; pis-

TABLE 1. Comparison of *Tapirira*, *Cyrtocarpa velutinifolia*, and *Cyrtocarpa*.

Character	<i>Tapirira</i>	<i>Cyrtocarpa velutinifolia</i>	<i>Cyrtocarpa</i>
Leaves			
Phenology	evergreen	deciduous	deciduous
Leaflets	petiolulate	subsessile	subsessile
Venation	usually brochidodromous	eucamptodromous	eucamptodromous
Indumentum	along veins	all of surface	all of surface
Flowers			
Pistil(lode)	pubescent	glabrous	glabrous
Ovary	1-locular	1-3(-4)-locular	2-5-locular*
Fruit			
Shape	subsymmetric	oblique	oblique
Stone	usually cartilaginous	bony	bony
Operculum	absent	present (1)	present (2-5)

* Engler (1882) misinterpreted the ovary of *Cyrtocarpa* as 1-2-locular.

tillode consisting of five styllodes; pistil doliform, styles separate, glabrous or papillate (vs. densely pubescent in *Tapirira*), ovary 1-5-locular. *Fruit* a drupe, purple or yellow to orange at maturity, obliquely obtuse-oblong, styles often persistent, surface often pubescent (vs. glabrous in *Spondias*), exocarp thin, mesocarp fleshy, endocarp bony, with 1-5 opercula; seeds apparently 1, testa with saddle-shaped patch corresponding to the hilum, cotyledons reniform.

KEY TO THE SPECIES OF *CYRTOCARPA*

- 1a. Secondary axes of inflorescence pseudospicate *C. velutinifolia*
- 1b. Secondary axes of inflorescence paniculate.
 - 2a. Lateral leaflets broadly elliptic to broadly (ob)ovate; anther connective not glandular-mucronulate; flowers 8 mm diam. *C. edulis*
 - 2b. Lateral leaflets lanceolate to narrowly elliptic; anther connective glandular-mucronulate; flowers 4-6 mm diam.
 - 3a. Ovary 2-5-locular; upper leaflets frequently alternate; filaments 1.8-2 mm long, anthers 1 mm long; pistillode not exceeding disk; western Mexico *C. procera*
 - 3b. Ovary 1-locular; upper leaflets always opposite; filaments 1.3-1.5 mm long, anthers 0.5 mm long; pistillode exceeding disk; Bahia, Brazil .. *C. caatingae*

Cyrtocarpa velutinifolia (Cowan) Mitchell & Daly, comb. nov. *Bursera velutinifolia* Cowan, Brittonia 7: 401-402. 1952. *Tapirira velutinifolia* Marcano-Berti, Pittieria 13: 23. 1986. TYPE: Guyana: Sand Creek, Rupununi River, Sep. 1948, *Wilson-Browne* 112 (F.D. 5650) (holotype, NY). Figures 1, 2.

Loxopterygium gutierrezii Barkley, Lloydia 25: 121-122. 1962. TYPE: Colombia. Magdalena: 200 m alt. near Masinga, near Santa Marta, 22 Jan. 1899, *H. H. Smith* 911 (holotype, NY; isotypes, A, BM, F, K, MICH, US).

The principal characters that have been used to separate genera in the Spondiadeae are the leaf venation; number of carpels; number of styles; degree of fusion of the styles; number of locules; structure of the mesocarp; presence or absence of opercula in the stone; other characters of the endocarp; and number of seeds developing per fruit (Engler, 1882; Hill, 1933, 1937; Kostermans, 1981; von Teichman, 1987; von Teichman & Robbertse, 1986; von Teichman & van Wyk, 1988; Wannan, 1986). The generic limits in the Spondiadeae are not clear in many cases, but there are consistent qualitative characters that can be used to distinguish *Tapirira* and *Cyrtocarpa*.

Tapirira is characterized by evergreen leaves; petiolulate lateral leaflets, usually with brochidodromous venation; densely pubescent pistil and pistillode; consistently unilocular ovary; subsymmetric fruit; and inoperculate stone. In contrast, *Cyrtocarpa* has deciduous leaves; (sub)sessile lateral leaflets with eucamptodromous venation; glabrous pistil and pistillode; 1-5-locular ovary; oblique fruit; and operculate stone.

Bursera velutinifolia possesses all the characters of *Cyrtocarpa*. Removal of the exocarp and mesocarp from fruits of *Boom & Eisenberg* 6056 (MO, NY) and of *Aristiguieta* 6090 (MO, NY) revealed a single operculum, located subapically on the anterior face of the stone (see Fig. 2). The genus most closely related to *Cyrtocarpa*, *Operculicarya* H. Perrier from Madagascar, also has

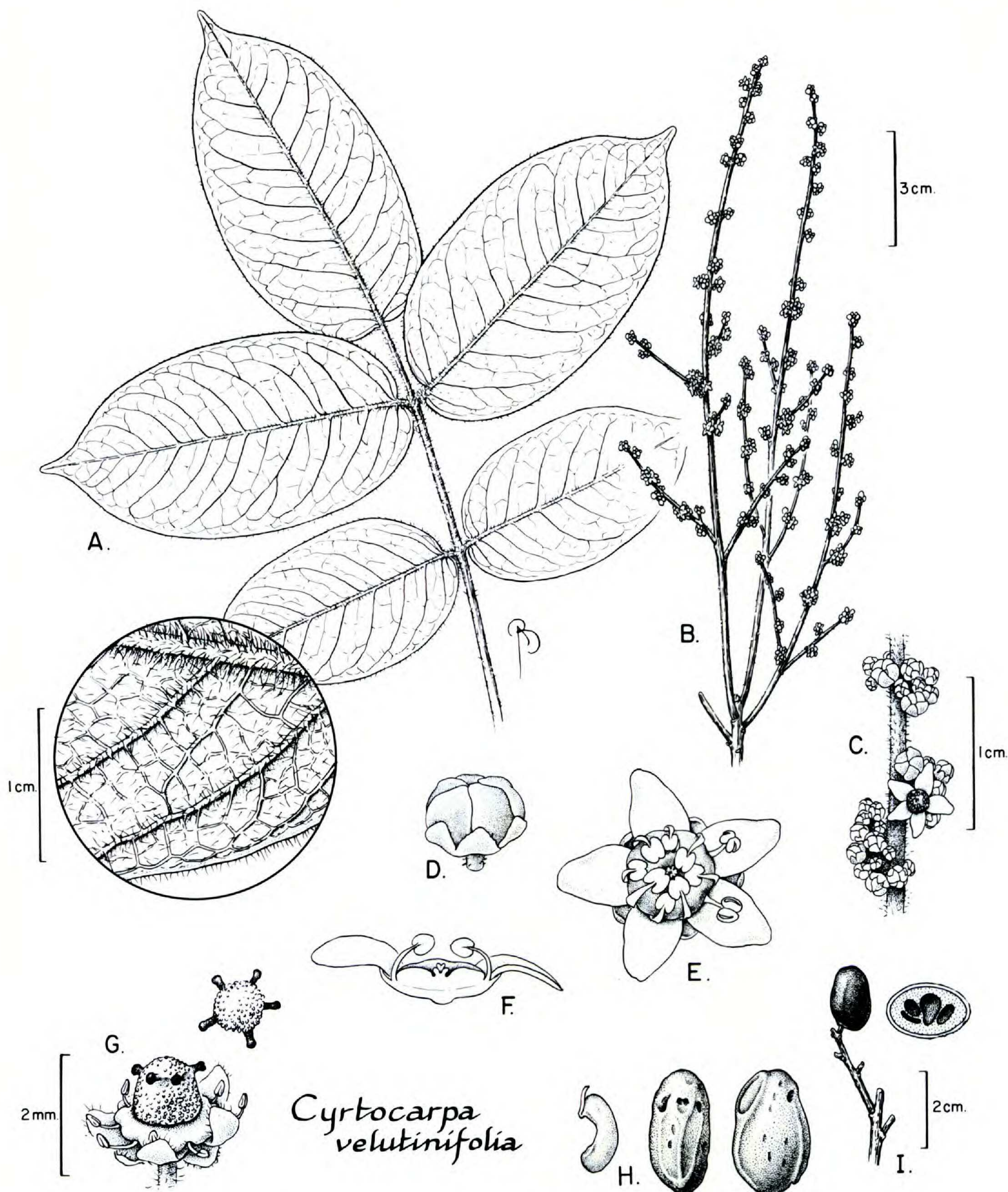


FIGURE 2. *Cyrtocarpa velutinifolia* (Cowan) Mitchell & Daly.—A. Part of mature leaf, including detail of abaxial leaflet surface.—B. Staminate inflorescence, showing pseudospicate structure.—C. Detail of staminate inflorescence, showing reduced tertiary axes.—D. Bud.—E. Top view of staminate flower.—F. Longisection of staminate flower, showing pistillode not exceeding disk.—G. Pistillate flower, post-anthesis, including top view of pistil.—H. Embryo; dorsiventral and lateral views of stone, showing operculum.—I. Portion of infructescence; transsection of drupe. Based on *Bunting* 4777 (A), *Goodland* 1046 (B, C), *Wilson-Browne* 518 (F.D. 5919) (D-F), *Wingfield* 1011 (G, I), and *Aristiguieta* 6090 (H).

unioperculate stones, but it is evergreen and has horseshoe-shaped (vs. reniform) cotyledons and usually five stamens.

The operculum of the stone is a structure associated with a specialized germination mechanism (Hill, 1933, 1937). It functions as a door in the protective woody tissue of the stone through which the seed germinates. In the Anacardiaceae, operculate stones are restricted to 10 of the 18 genera in the tribe Spondiadeae.

Additional specimens examined. VENEZUELA. APURE: Distrito Pedro Camejo, Piedra de San Vicente, 9 airline km N of Puerto Paez; 6°18'N, 67°27'W, 80–160 m, 26 Feb. 1978, *Davidse & A. González 14581* (VEN). ARA-GUA: Parque Nacional Henri Pittier, near limit of El Piñal (N of Maracay), at foot of cerro, 500–600 m, 12 May 1972, *Bunting 4777* (NY). BOLÍVAR: Parque Caroní, Sep. 1965, *Aristiguieta 5877* (NY); Distrito Cedeño, valley of Caño Colorado, vic. of Panare Indian village, 30 km SW of National Guard post Maniapure, ca. 200 m, 6°45'N, 66°37'W, 5–7 Apr. 1985, *Boom & Eisenberg 6056* (K, MO, NY); Represa Guri, ca. 55 km NE of Ciudad Piar, elev. 250–300 m, ca. 7°35'N, 63°07'W, 4–5 Apr. 1981, *Liesner & González 11243* (MO, NY); upstream on Rio Asa from Raudal Cotúa, 2 Aug. 1960, *Steyermark 86814* (NY); northernmost slopes of Cerro Baraguán, 100–330 m, 13 Jan. 1956, *Wurdack & Monachino 41240* (NY). CARABOBO: vic. of Valencia, 400–800 m, Dec. 1919, *Pittier 8679* (NY). FALCON: Distrito Democracia, Pueblo Nuevo, 20 km S of Urumaco, 520 m, 24 June 1982, *R. Wingfield 1011* (K). GUARICO: forests of Tamanaco, Altagracia de Orituco–Chaguaramas, May 1966, *Aristiguieta 6090* (NY); near Paso Real, June 1966, *Aristiguieta 6165* (NY). PORTUGUESA: Distrito Guanare, Mesa de Cavacas, property of UNELLEZ, 200 m, 9°04'N, 69°49'W, 5 Sep. 1988, *Aymard & Cuello 7024* (NY, PORT). ZULIA: Distrito Miranda, vic. of El Consejo de Ciruma, near spring of El Cardón, 150–200 m, 7 Aug. 1979, *Bunting 7872* (NY). GUYANA: Rupununi northern savanna, Moreru [Moreiro], 21 Oct. 1963, *Goodland 1046* (NY); Iramaipang, Kanuku Mts., *Wilson-Browne 518* (F.D. 5919) (NY). BRAZIL. RORAIMA: Rio Uraricoera, Cachoeira Urubu, 18 Nov. 1979, *Pires et al. 16709* (NY).

***Cyrtocarpa caatingae* Mitchell & Daly, sp. nov.**

TYPE: Brazil. Bahia: Mun. Manoel Vitorino, 1–5 km W of Manoel Vitorino on road to Catingal, 20 Nov. 1978, *S. A. Mori, T. S. Santos & C. B. Thompson 11248* (holotype, CEPEC; isotypes, ILL, K, NY, RB). Figures 1, 3.

Cyrtocarpace procerae ob inflorescentiam paniculatam, foliola lanceolata vel anguste elliptica, et connectivum antheridii glanduloso-mucronulatum similis et affinis; ab eo autem ob ovarium uniloculare (nec 2–5-loculare), stamina breviora, et pistillodium discum superans differt.

Deciduous, dioecious shrub or small tree ca. 3.5 m tall. Branch apices somewhat fleshy (drying wrinkled). Leaves (only immature ones known) flushing

at time of flowering, congested near the apices, 3–5-jugate; leaflets lanceolate to narrowly elliptic, lateral ones subsessile with truncate and slightly oblique base, terminal ones petiolulate with acute base, apex obtuse and apiculate, venation eucamptodromous, leaf surfaces sericeous, with dense, ascending trichomes 0.2–0.4 mm long. Inflorescences subterminal, paniculate, 6–11.7 cm long, peduncle ca. 2.5–3 cm long, secondary axes 0.5–2 cm long, tertiary axes 1.5–6 mm long, pedicels 1.5–2 mm (staminate flowers) and 2–2.5 mm (pistillate) long. Flowers greenish, 5-merous and diplostemonous, 4 mm diam.; calyx teeth semicircular, fleshy, 1 × 0.7 mm, pubescence as on inflorescences, margin ciliate; petals oblong, 2–2.4 × 1 mm, glabrous, veins arcuate and branching. Staminate flowers with filaments 1.5 mm (antepetalous) and 2 mm (antesepalous) long, anthers broadly elliptic, 0.6 mm long, connective glandular-mucronulate, apiculum drying black; disk thin; pistillode consisting of 3–5 stylodes, each 0.6 mm long, greatly exceeding disk. Pistillate flowers with filaments 1.5 and 2 mm long, anthers in dorsiventral view lanceolate, 0.4–0.5 mm long; pistil doliform with rounded apex, 1–1.5 mm × 0.7–1 mm, glabrous, styles 5, 0.2–0.25 mm long, separate, spreading, stigmas discoid; locule 1, ovule 1, pendent. Developing fruit obliquely oblong, apex obtuse, styles persistent, mature fruit unknown.

Paratypes. BRAZIL. s.l., 1816–1821, *Saint-Hilaire s.n.* (P). BAHIA: Igreja Velha, 1841, *Blanchet 3418* (NY; P—2 sheets); caatinga near Caldeirão, Oct. 1906, *Ule 7256* (K).

Distribution. Caatinga (dry thorn-scrub) of the interior of Bahia. Because the flora of the caatingas of northeastern Brazil is still not well represented in herbaria (Mori, 1989), it is not possible to say just how rare *Cyrtocarpa caatingae* is. In addition, the herbarium labels on the older collections that represent this species provide almost no details about its habitat, habit, or phenology.

Cyrtocarpa caatingae resembles *C. procera* because of its paniculate inflorescence, lanceolate to narrowly elliptic leaflets, and glandular-mucronulate anther connective. The new species differs by its unilocular (vs. 2–5-locular) ovary, shorter stamens, and pistillode greatly exceeding (not exceeded by) the disk. While the occurrence of *Cyrtocarpa* in the semiarid climate of the caatingas is consistent with its habitat preference elsewhere, the ranges of the four species of *Cyrtocarpa* are markedly discontinuous (see Fig. 1), interrupted over long distances by moister habitats, or by water in the case of the two Mexican species.

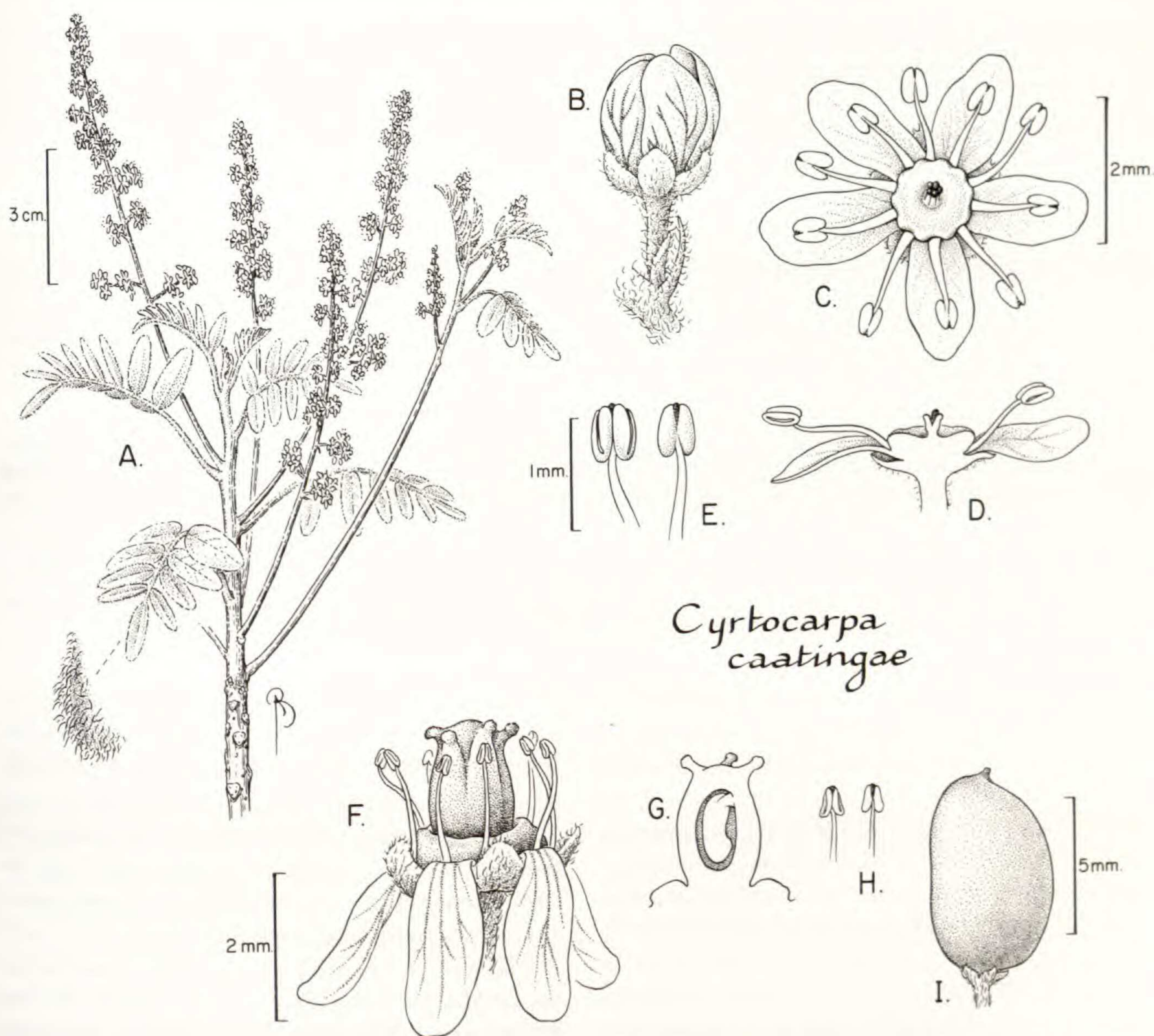


FIGURE 3. *Cyrtocarpa caatingae* Mitchell & Daly. —A. Staminate-flowering branchlet with immature leaves. —B. Opening flower. —C. Staminate flower at anthesis. —D. Longisection of flower, showing pistillode exceeding the disk. —E. Stamens, showing glandular-mucronulate anther connective. —F. Pistillate flower, post-anthesis. —G. Longisection of ovary, showing single locule. —H. Stamminodes. —I. Immature fruit. Based on *Mori et al.* 11248 (type; A–E), and *St. Hilaire s.n.* (F–I).

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